## BAN 502

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## Clustering Assingment

## Task 1

library(tidyverse)

## -- Attaching packages ----------------------------------------------------------- tidyverse 1.2.1 --

## v ggplot2 3.1.0 v purrr 0.2.5  
## v tibble 1.4.2 v dplyr 0.7.7  
## v tidyr 0.8.2 v stringr 1.3.1  
## v readr 1.1.1 v forcats 0.3.0

## -- Conflicts -------------------------------------------------------------- tidyverse\_conflicts() --  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()

library(cluster)  
library("factoextra")

## Welcome! Related Books: `Practical Guide To Cluster Analysis in R` at https://goo.gl/13EFCZ

library("dendextend")

##   
## ---------------------  
## Welcome to dendextend version 1.9.0  
## Type citation('dendextend') for how to cite the package.  
##   
## Type browseVignettes(package = 'dendextend') for the package vignette.  
## The github page is: https://github.com/talgalili/dendextend/  
##   
## Suggestions and bug-reports can be submitted at: https://github.com/talgalili/dendextend/issues  
## Or contact: <tal.galili@gmail.com>  
##   
## To suppress this message use: suppressPackageStartupMessages(library(dendextend))  
## ---------------------

##   
## Attaching package: 'dendextend'

## The following object is masked from 'package:stats':  
##   
## cutree

trucks <- read\_csv("trucks.csv")

## Parsed with column specification:  
## cols(  
## Driver\_ID = col\_double(),  
## Distance = col\_double(),  
## Speeding = col\_integer()  
## )

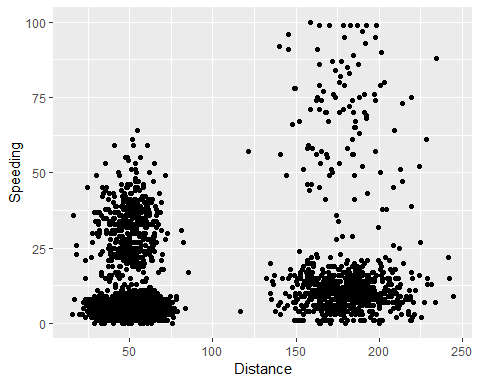
str(trucks)

## Classes 'tbl\_df', 'tbl' and 'data.frame': 4000 obs. of 3 variables:  
## $ Driver\_ID: num 3.42e+09 3.42e+09 3.42e+09 3.42e+09 3.42e+09 ...  
## $ Distance : num 71.2 52.5 64.5 55.7 54.6 ...  
## $ Speeding : int 28 25 27 22 25 10 20 8 34 19 ...  
## - attr(\*, "spec")=List of 2  
## ..$ cols :List of 3  
## .. ..$ Driver\_ID: list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## .. ..$ Distance : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## .. ..$ Speeding : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## ..$ default: list()  
## .. ..- attr(\*, "class")= chr "collector\_guess" "collector"  
## ..- attr(\*, "class")= chr "col\_spec"

summary(trucks)

## Driver\_ID Distance Speeding   
## Min. :3.423e+09 Min. : 15.52 Min. : 0.00   
## 1st Qu.:3.423e+09 1st Qu.: 45.25 1st Qu.: 4.00   
## Median :3.423e+09 Median : 53.33 Median : 6.00   
## Mean :3.423e+09 Mean : 76.04 Mean : 10.72   
## 3rd Qu.:3.423e+09 3rd Qu.: 65.63 3rd Qu.: 9.00   
## Max. :3.423e+09 Max. :244.79 Max. :100.00

ggplot(data = trucks)+ geom\_point(mapping= aes(x=Distance, y=Speeding))

 There is a cluster of drivers that drive under 75 miles with a small percentage of time they drive 5 or more mph over the speed limit. Also a cluster of drivers that driver 150-200 miles that drive 5 or more mph over the speed limit >25% of the time.

No missing data so will move on to scaling the data. (Note from lecture: This is critical for quantitative data to ensure that no variable (particularly a variable with large values, skews the data and the resulting clusters))

## Task 2

trucks2 = trucks %>% select("Distance","Speeding")  
as.data.frame(scale(trucks2))

## Distance Speeding  
## 1 -0.089799173 1.26045492  
## 2 -0.439717876 1.04161328  
## 3 -0.215104107 1.18750771  
## 4 -0.380618833 0.82277163  
## 5 -0.401378307 1.04161328  
## 6 -0.638335547 -0.05259494  
## 7 -0.325447258 0.67687721  
## 8 -0.449256013 -0.19848937  
## 9 -0.837701308 1.69813821  
## 10 -0.593450198 0.60392999  
## 11 -0.499190964 2.13582150  
## 12 -0.336107528 2.50055757  
## 13 -0.595133399 0.82277163  
## 14 -0.379870744 0.60392999  
## 15 -0.550061027 2.35466314  
## 16 -0.431488896 1.55224378  
## 17 -0.557167874 1.77108543  
## 18 -0.458046061 1.18750771  
## 19 -0.355183802 1.11456049  
## 20 -0.329000681 1.40634935  
## 21 -0.610095182 0.89571885  
## 22 -0.380805855 1.91697986  
## 23 -0.390718036 0.53098278  
## 24 -0.602240246 0.82277163  
## 25 -0.313851876 1.55224378  
## 26 -0.727545179 2.20876871  
## 27 -0.219592642 1.33340214  
## 28 -0.566518988 0.38508835  
## 29 -0.562404498 0.89571885  
## 30 -0.374073053 2.06287428  
## 31 -0.793002981 2.50055757  
## 32 -0.642824082 1.62519100  
## 33 -0.474317000 2.06287428  
## 34 -0.408111109 1.77108543  
## 35 -0.371080696 1.33340214  
## 36 -0.558851075 2.20876871  
## 37 -0.482920025 0.96866606  
## 38 -0.493393273 1.62519100  
## 39 -0.700052903 1.91697986  
## 40 -0.388286747 1.84403264  
## 41 -0.339847974 2.20876871  
## 42 -0.268405459 0.09329949  
## 43 -0.722495578 0.74982442  
## 44 -0.415404979 1.55224378  
## 45 -0.244279584 0.82277163  
## 46 -0.543702269 0.16624670  
## 47 -0.336855617 0.96866606  
## 48 -0.302443516 1.84403264  
## 49 0.099093339 1.47929657  
## 50 -0.513965725 1.11456049  
## 51 -1.091864599 0.89571885  
## 52 -0.561656409 0.74982442  
## 53 -0.574186902 1.11456049  
## 54 -0.680789607 1.47929657  
## 55 -0.464217796 1.84403264  
## 56 -0.744938252 1.47929657  
## 57 -0.537156489 3.23002972  
## 58 -0.395954661 1.18750771  
## 59 -0.319275522 -0.34438380  
## 60 -0.350508244 2.28171593  
## 61 -0.301134360 1.55224378  
## 62 -0.267844392 1.04161328  
## 63 -0.427374405 0.89571885  
## 64 -0.765136660 1.98992707  
## 65 -0.515648926 0.67687721  
## 66 -0.465152908 2.35466314  
## 67 -0.634034035 2.06287428  
## 68 -0.406427909 1.77108543  
## 69 -0.507045900 1.55224378  
## 70 -0.421389692 2.42761036  
## 71 -0.454866682 0.96866606  
## 72 -0.489652828 -0.05259494  
## 73 -0.501996299 2.20876871  
## 74 -0.296271780 2.06287428  
## 75 -0.411103466 0.67687721  
## 76 -0.058566451 1.40634935  
## 77 -0.264103947 2.13582150  
## 78 -0.595507443 0.96866606  
## 79 -0.285985554 2.06287428  
## 80 -0.143661592 1.91697986  
## 81 -0.367527273 0.67687721  
## 82 -0.707907839 0.31214113  
## 83 -0.184245429 1.18750771  
## 84 -0.333676238 0.45803556  
## 85 -0.532854976 0.82277163  
## 86 -0.718568110 0.38508835  
## 87 -1.089059265 1.11456049  
## 88 -0.837701308 1.33340214  
## 89 -0.281309997 2.20876871  
## 90 -0.655728620 1.62519100  
## 91 -0.418023291 0.96866606  
## 92 -0.459729261 -0.12554216  
## 93 -0.214543040 1.33340214  
## 94 -0.416153068 0.89571885  
## 95 -0.219966686 1.69813821  
## 96 -0.703793349 0.96866606  
## 97 -0.320771700 2.28171593  
## 98 -0.596068510 1.62519100  
## 99 -0.479366602 2.35466314  
## 100 -0.232123135 1.26045492  
## 101 -0.565957922 0.96866606  
## 102 -0.382115011 0.67687721  
## 103 -0.164795111 -0.41733102  
## 104 -0.492832206 1.98992707  
## 105 -0.401004262 1.40634935  
## 106 -0.656476710 3.52181858  
## 107 -0.602240246 1.84403264  
## 108 -0.368088339 0.60392999  
## 109 -0.121779984 0.89571885  
## 110 -0.459355217 0.60392999  
## 111 -0.432236985 2.20876871  
## 112 -0.383798212 -0.19848937  
## 113 -0.447011746 0.89571885  
## 114 -0.246523851 0.74982442  
## 115 -0.720251310 1.62519100  
## 116 -0.235115492 1.04161328  
## 117 -0.260550523 1.62519100  
## 118 -0.608224959 1.04161328  
## 119 -0.525000040 1.18750771  
## 120 -0.631602745 1.91697986  
## 121 -0.373886030 1.40634935  
## 122 -0.261111590 1.91697986  
## 123 -0.762892392 3.08413529  
## 124 -0.677610228 1.04161328  
## 125 -0.294962624 1.62519100  
## 126 -0.423259915 0.82277163  
## 127 -0.369584518 1.18750771  
## 128 -0.425130138 1.04161328  
## 129 -0.389034836 1.40634935  
## 130 -0.581106727 1.33340214  
## 131 -0.668446136 2.35466314  
## 132 -0.539774801 2.28171593  
## 133 -0.554362540 1.69813821  
## 134 -0.765510704 0.31214113  
## 135 -0.406053864 1.98992707  
## 136 -0.401191285 3.88655465  
## 137 -0.268779504 2.86529365  
## 138 -0.442336188 0.60392999  
## 139 -0.442710233 -0.34438380  
## 140 -0.658346932 1.04161328  
## 141 -0.909330845 1.18750771  
## 142 -0.584473128 1.47929657  
## 143 -0.303004583 1.91697986  
## 144 -0.748865720 2.50055757  
## 145 -0.531171776 -0.05259494  
## 146 -0.452435392 1.91697986  
## 147 -0.305061828 0.31214113  
## 148 -0.618698207 1.91697986  
## 149 -0.452622414 1.18750771  
## 150 -0.307119073 0.89571885  
## 151 -0.322080856 1.40634935  
## 152 -0.469641443 1.40634935  
## 153 -0.648808796 0.89571885  
## 154 -0.962445175 2.50055757  
## 155 -0.342279264 0.82277163  
## 156 -0.708842951 1.62519100  
## 157 -0.452996459 0.67687721  
## 158 -0.648434751 0.45803556  
## 159 -0.393336349 0.96866606  
## 160 -0.214730062 3.08413529  
## 161 -0.560160231 1.77108543  
## 162 -0.340970108 0.67687721  
## 163 -0.556045740 0.89571885  
## 164 -0.176203471 1.91697986  
## 165 -0.620007363 0.45803556  
## 166 -0.658720977 0.89571885  
## 167 -0.476748290 2.20876871  
## 168 -0.666014846 2.13582150  
## 169 -0.424195026 1.04161328  
## 170 -0.583725039 1.18750771  
## 171 -0.751297010 1.77108543  
## 172 -0.544076314 0.89571885  
## 173 -0.529114531 0.67687721  
## 174 -0.353874645 1.11456049  
## 175 -0.710900196 2.35466314  
## 176 -0.406427909 2.50055757  
## 177 -0.481610869 2.06287428  
## 178 -0.793751070 0.96866606  
## 179 -0.578114370 2.42761036  
## 180 -0.829659349 1.47929657  
## 181 -0.068852677 -0.49027823  
## 182 -0.516397015 3.23002972  
## 183 -0.590270819 1.84403264  
## 184 -0.364721938 0.67687721  
## 185 -0.410168355 2.86529365  
## 186 -0.496198608 1.33340214  
## 187 -0.474691044 1.84403264  
## 188 -0.265974170 0.89571885  
## 189 -0.478618512 0.31214113  
## 190 -0.156005063 2.35466314  
## 191 -0.643946216 0.09329949  
## 192 -0.680976629 1.47929657  
## 193 -0.747369542 1.47929657  
## 194 -0.577179259 1.18750771  
## 195 -0.499565009 1.26045492  
## 196 -0.512095502 2.50055757  
## 197 -0.415779023 1.04161328  
## 198 -0.756907679 2.42761036  
## 199 -0.508916123 2.06287428  
## 200 -0.129073854 2.13582150  
## 201 -0.285985554 3.52181858  
## 202 -0.449443035 2.06287428  
## 203 -0.526683241 2.50055757  
## 204 -0.668446136 1.40634935  
## 205 -0.514713814 1.40634935  
## 206 -0.392401237 1.91697986  
## 207 -0.516022970 1.26045492  
## 208 -0.325260235 2.13582150  
## 209 -0.126268519 0.74982442  
## 210 -0.455240726 0.74982442  
## 211 -0.113925048 0.53098278  
## 212 -0.430179740 1.91697986  
## 213 -0.525000040 1.18750771  
## 214 -0.225016288 1.11456049  
## 215 -0.267096303 0.89571885  
## 216 -0.487408560 1.26045492  
## 217 0.110688721 1.18750771  
## 218 -0.364347894 1.04161328  
## 219 -0.455427749 1.40634935  
## 220 -0.396702750 2.13582150  
## 221 -0.394084438 2.06287428  
## 222 -0.597938733 1.18750771  
## 223 -0.562778543 2.13582150  
## 224 -0.632163812 0.82277163  
## 225 -0.608224959 2.79234643  
## 226 -0.462160551 1.47929657  
## 227 -0.362103626 3.23002972  
## 228 -0.467210153 0.96866606  
## 229 -0.637587458 1.26045492  
## 230 -0.420454580 1.18750771  
## 231 -0.527057285 2.50055757  
## 232 -0.604110469 1.69813821  
## 233 -0.651240085 2.06287428  
## 234 -0.565209832 2.28171593  
## 235 -0.585408240 1.04161328  
## 236 -0.414469867 1.40634935  
## 237 -0.591766997 1.33340214  
## 238 -0.318527433 1.77108543  
## 239 -0.425878227 0.60392999  
## 240 -0.568950278 1.04161328  
## 241 -0.427935472 3.08413529  
## 242 -0.470015487 2.93824086  
## 243 -0.795060226 2.28171593  
## 244 -0.544637381 1.62519100  
## 245 -0.314225920 1.77108543  
## 246 -0.517519149 1.55224378  
## 247 -0.482171936 0.74982442  
## 248 -0.708842951 1.40634935  
## 249 -0.236050603 1.11456049  
## 250 -0.347515888 0.23919392  
## 251 -0.229130779 1.62519100  
## 252 -0.334985394 1.40634935  
## 253 -0.368275362 2.20876871  
## 254 -0.431862940 -0.56322544  
## 255 -0.381366922 1.18750771  
## 256 -0.871552342 1.69813821  
## 257 -0.494889452 2.06287428  
## 258 -0.836766196 1.62519100  
## 259 -0.608973048 1.33340214  
## 260 -0.506858878 1.69813821  
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## 262 -0.415404979 1.84403264  
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## 265 -0.655915643 2.28171593  
## 266 -0.500313098 0.74982442  
## 267 -0.373699008 1.69813821  
## 268 -0.184806496 1.55224378  
## 269 -0.812266277 0.89571885  
## 270 -0.723243667 1.04161328  
## 271 -0.561095342 1.98992707  
## 272 -0.352939534 1.62519100  
## 273 -0.654232442 1.47929657  
## 274 -0.539213734 1.84403264  
## 275 -0.379683721 2.42761036  
## 276 -0.368462384 1.04161328  
## 277 -0.271397816 0.02035227  
## 278 -0.273829106 1.98992707  
## 279 -0.318153388 1.33340214  
## 280 -0.921674316 0.82277163  
## 281 -0.519950438 1.69813821  
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## 283 -0.220527753 1.26045492  
## 284 -0.990872563 0.31214113  
## 285 -0.538465645 0.89571885  
## 286 -0.315161032 1.62519100  
## 287 -0.810396054 0.45803556  
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## 292 -1.121975188 1.84403264  
## 293 -0.421763736 2.93824086  
## 294 -0.352565489 0.60392999  
## 295 -0.498629897 1.91697986  
## 296 -0.696125435 0.38508835  
## 297 -0.489278783 1.91697986  
## 298 -0.509290168 1.40634935  
## 299 -0.321332767 2.28171593  
## 300 -0.576431170 2.06287428  
## 301 -0.501061187 1.04161328  
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## 306 -0.484977270 1.69813821  
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## 315 -0.541458002 1.18750771  
## 316 -0.789262535 1.77108543  
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## 318 -0.373137941 -0.12554216  
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## 322 -0.513965725 1.91697986  
## 323 -0.750548921 1.40634935  
## 324 -0.336668595 1.26045492  
## 325 -0.727171135 0.60392999  
## 326 -0.628236344 0.38508835  
## 327 -0.250451320 2.20876871  
## 328 -0.460477350 1.77108543  
## 329 -0.556045740 0.82277163  
## 330 -0.461599484 1.62519100  
## 331 -0.232310157 2.20876871  
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## 341 -0.338351795 0.74982442  
## 342 -0.423446937 2.50055757  
## 343 -0.481049802 2.13582150  
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## 346 -0.608973048 0.31214113  
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## 348 -0.643946216 -0.49027823  
## 349 -0.885017947 1.91697986  
## 350 -0.424008004 2.13582150  
## 351 -0.715014686 1.69813821  
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## 353 -0.426626316 2.13582150  
## 354 -0.609160070 1.62519100  
## 355 -0.214917085 1.40634935  
## 356 -0.312355697 1.98992707  
## 357 -0.862575272 2.79234643  
## 358 -0.568015167 2.06287428  
## 359 -0.580732682 1.84403264  
## 360 -0.467023130 0.16624670  
## 361 -0.339847974 1.98992707  
## 362 -0.339286907 1.69813821  
## 363 -0.572877746 1.55224378  
## 364 -0.169657691 1.62519100  
## 365 -0.498816920 2.13582150  
## 366 -0.495637541 0.74982442  
## 367 -0.454679659 3.66771301  
## 368 -0.867063807 1.40634935  
## 369 -0.185554585 1.98992707  
## 370 -0.436912542 1.40634935  
## 371 -0.481049802 2.57350479  
## 372 -0.240165094 2.13582150  
## 373 -0.578301393 1.04161328  
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## 375 -0.472633799 1.55224378  
## 376 -0.524438973 0.89571885  
## 377 -0.386790568 2.64645200  
## 378 -0.428870583 2.71939922  
## 379 -0.701923126 1.26045492  
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## 383 -0.134310478 1.47929657  
## 384 -0.292531335 1.26045492  
## 385 -0.723991756 1.98992707  
## 386 -0.306932051 0.96866606  
## 387 -0.787766357 2.35466314  
## 388 -0.599621934 -0.34438380  
## 389 -0.417088179 1.47929657  
## 390 -0.571007523 1.62519100  
## 391 -0.391840170 0.60392999  
## 392 -0.134123456 0.53098278  
## 393 -0.329187703 0.60392999  
## 394 -0.603923446 0.60392999  
## 395 -0.541832046 1.62519100  
## 396 -0.526496218 1.26045492  
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## 3879 1.774064962 0.31214113  
## 3880 1.698694979 0.31214113  
## 3881 1.659420299 -0.34438380  
## 3882 2.027480164 0.09329949  
## 3883 2.165315591 -0.27143659  
## 3884 2.011770292 0.23919392  
## 3885 1.783790121 -0.49027823  
## 3886 2.066754845 -0.19848937  
## 3887 2.325219649 -0.34438380  
## 3888 1.695889645 -0.12554216  
## 3889 2.175788839 -0.05259494  
## 3890 1.418348568 -0.49027823  
## 3891 2.253964156 -0.70911987  
## 3892 1.802679372 0.02035227  
## 3893 1.750500154 -0.12554216  
## 3894 1.894320294 -0.70911987  
## 3895 1.509615445 0.31214113  
## 3896 1.677935505 -0.41733102  
## 3897 1.877488288 0.02035227  
## 3898 1.553565683 0.38508835  
## 3899 2.068999112 0.31214113  
## 3900 1.744515440 -0.05259494  
## 3901 1.902736297 0.02035227  
## 3902 1.957907872 -0.70911987  
## 3903 2.359070683 -0.70911987  
## 3904 1.557306129 -0.05259494  
## 3905 1.697385823 -0.05259494  
## 3906 1.889831759 -0.27143659  
## 3907 1.768454293 -0.56322544  
## 3908 2.133895847 0.16624670  
## 3909 2.337937164 -0.12554216  
## 3910 1.849060900 0.23919392  
## 3911 1.720015520 0.31214113  
## 3912 1.439108042 -0.34438380  
## 3913 1.292856612 0.31214113  
## 3914 1.840270852 -0.12554216  
## 3915 1.972682633 0.23919392  
## 3916 2.042815992 -0.12554216  
## 3917 1.876366154 0.02035227  
## 3918 1.568714488 0.31214113  
## 3919 1.387115846 -0.70911987  
## 3920 1.431814173 0.31214113  
## 3921 2.275471720 -0.12554216  
## 3922 1.846629610 -0.49027823  
## 3923 1.499142197 -0.49027823  
## 3924 1.841392986 -0.34438380  
## 3925 2.512803005 -0.05259494  
## 3926 2.319234935 -0.12554216  
## 3927 1.662973722 -0.41733102  
## 3928 1.878797444 0.02035227  
## 3929 2.184765909 0.74982442  
## 3930 2.097987567 -0.19848937  
## 3931 1.917511058 0.45803556  
## 3932 2.381513358 -0.19848937  
## 3933 2.174666706 0.23919392  
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## 3935 1.506810111 0.67687721  
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## 3947 1.447711067 -0.70911987  
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## 3950 2.477642814 -0.41733102  
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## 3958 1.813152621 -0.05259494  
## 3959 1.989888684 -0.05259494  
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## 3961 1.450142357 0.09329949  
## 3962 2.050483906 0.53098278  
## 3963 2.595092812 0.67687721  
## 3964 2.045060259 0.67687721  
## 3965 1.745076507 0.60392999  
## 3966 1.976984146 -0.05259494  
## 3967 1.568153422 0.45803556  
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## 3970 2.172609461 -0.19848937  
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## 3975 1.769202383 0.16624670  
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## 3979 2.680936043 -0.70911987  
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## 3983 2.182521642 0.16624670  
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## 3985 2.129033267 -0.12554216  
## 3986 1.674569104 -0.34438380  
## 3987 2.166437725 -0.27143659  
## 3988 2.210200941 0.09329949  
## 3989 1.705240760 -0.63617266  
## 3990 2.044686215 0.23919392  
## 3991 2.389368294 0.82277163  
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## 3993 1.897125628 0.60392999  
## 3994 1.761347446 0.38508835  
## 3995 2.500833578 0.53098278  
## 3996 1.570958756 -0.05259494  
## 3997 1.872625709 -0.41733102  
## 3998 1.774251984 0.09329949  
## 3999 1.872064642 -0.41733102  
## 4000 1.720389565 -0.12554216

str(trucks2)

## Classes 'tbl\_df', 'tbl' and 'data.frame': 4000 obs. of 2 variables:  
## $ Distance: num 71.2 52.5 64.5 55.7 54.6 ...  
## $ Speeding: int 28 25 27 22 25 10 20 8 34 19 ...  
## - attr(\*, "spec")=List of 2  
## ..$ cols :List of 3  
## .. ..$ Driver\_ID: list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## .. ..$ Distance : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## .. ..$ Speeding : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## ..$ default: list()  
## .. ..- attr(\*, "class")= chr "collector\_guess" "collector"  
## ..- attr(\*, "class")= chr "col\_spec"

summary(trucks2)

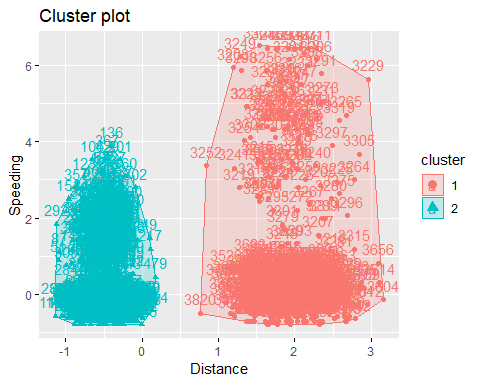
## Distance Speeding   
## Min. : 15.52 Min. : 0.00   
## 1st Qu.: 45.25 1st Qu.: 4.00   
## Median : 53.33 Median : 6.00   
## Mean : 76.04 Mean : 10.72   
## 3rd Qu.: 65.63 3rd Qu.: 9.00   
## Max. :244.79 Max. :100.00

## Task 3

set.seed(1234)  
clusters1 <- kmeans(trucks2, 2)

Visualize the clustering

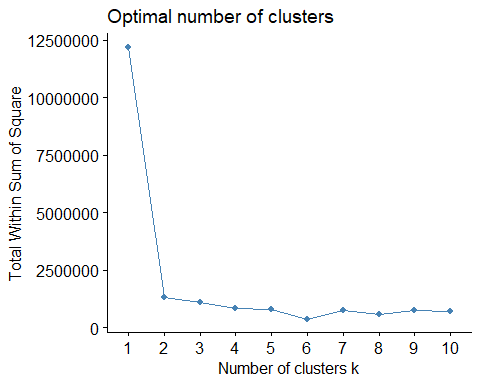
fviz\_cluster(clusters1, trucks2)



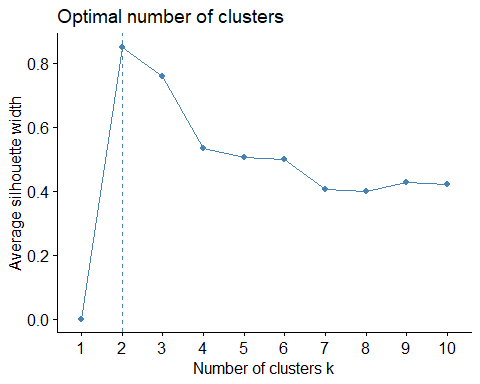
## Task 4

Visually identify optimal number of clusters. Both models indicate 2 clusters as being optimal so we will go with that.

set.seed(123)  
fviz\_nbclust(trucks2, kmeans, method = "wss") #minimize within-cluster variation

 Another method

set.seed(123)  
fviz\_nbclust(trucks2, kmeans, method = "silhouette") #maximize how well points sit in their clusters

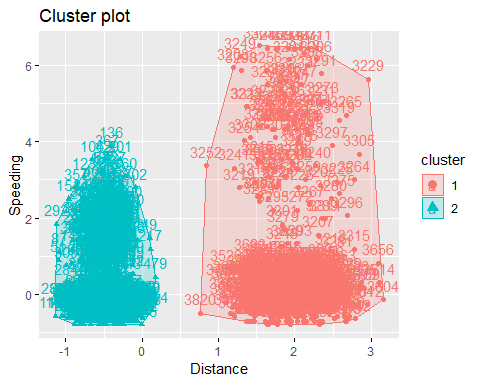


## Task 5

set.seed(1234)  
clusters2 <- kmeans(trucks2, 2)  
clusters2

## K-means clustering with 2 clusters of sizes 800, 3200  
##   
## Cluster means:  
## Distance Speeding  
## 1 180.01707 18.29000  
## 2 50.04763 8.82875  
##   
## Clustering vector:  
## [1] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [35] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [69] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [103] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
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## [3979] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1  
##   
## Within cluster sum of squares by cluster:  
## [1] 668369.7 648051.1  
## (between\_SS / total\_SS = 89.2 %)  
##   
## Available components:  
##   
## [1] "cluster" "centers" "totss" "withinss"   
## [5] "tot.withinss" "betweenss" "size" "iter"   
## [9] "ifault"

fviz\_cluster(clusters2, trucks2)



## Task 6

Cluster 2= shorter distances smaller percentage of time driven 5 miles or more over speed limit cluster 1 = longer distances you will see higher percentages of time driving 5 or more over the speed limit.

## Task 7

wineprice <- read\_csv("wineprice.csv")

## Parsed with column specification:  
## cols(  
## Year = col\_integer(),  
## Price = col\_double(),  
## WinterRain = col\_integer(),  
## AGST = col\_double(),  
## HarvestRain = col\_integer(),  
## Age = col\_integer(),  
## FrancePop = col\_double()  
## )

str(wineprice)

## Classes 'tbl\_df', 'tbl' and 'data.frame': 25 obs. of 7 variables:  
## $ Year : int 1952 1953 1955 1957 1958 1959 1960 1961 1962 1963 ...  
## $ Price : num 7.5 8.04 7.69 6.98 6.78 ...  
## $ WinterRain : int 600 690 502 420 582 485 763 830 697 608 ...  
## $ AGST : num 17.1 16.7 17.1 16.1 16.4 ...  
## $ HarvestRain: int 160 80 130 110 187 187 290 38 52 155 ...  
## $ Age : int 31 30 28 26 25 24 23 22 21 20 ...  
## $ FrancePop : num 43184 43495 44218 45152 45654 ...  
## - attr(\*, "spec")=List of 2  
## ..$ cols :List of 7  
## .. ..$ Year : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## .. ..$ Price : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## .. ..$ WinterRain : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## .. ..$ AGST : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## .. ..$ HarvestRain: list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## .. ..$ Age : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## .. ..$ FrancePop : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## ..$ default: list()  
## .. ..- attr(\*, "class")= chr "collector\_guess" "collector"  
## ..- attr(\*, "class")= chr "col\_spec"

summary(wineprice)

## Year Price WinterRain AGST   
## Min. :1952 Min. :6.205 Min. :376.0 Min. :14.98   
## 1st Qu.:1960 1st Qu.:6.519 1st Qu.:536.0 1st Qu.:16.20   
## Median :1966 Median :7.121 Median :600.0 Median :16.53   
## Mean :1966 Mean :7.067 Mean :605.3 Mean :16.51   
## 3rd Qu.:1972 3rd Qu.:7.495 3rd Qu.:697.0 3rd Qu.:17.07   
## Max. :1978 Max. :8.494 Max. :830.0 Max. :17.65   
## HarvestRain Age FrancePop   
## Min. : 38.0 Min. : 5.0 Min. :43184   
## 1st Qu.: 89.0 1st Qu.:11.0 1st Qu.:46584   
## Median :130.0 Median :17.0 Median :50255   
## Mean :148.6 Mean :17.2 Mean :49694   
## 3rd Qu.:187.0 3rd Qu.:23.0 3rd Qu.:52894   
## Max. :292.0 Max. :31.0 Max. :54602

wine2 = wineprice %>% select("Price","WinterRain", "AGST", "HarvestRain", "Age")  
as.data.frame(scale(wine2))

## Price WinterRain AGST HarvestRain Age  
## 1 0.65777198 -0.03991595 0.89926984 0.1537232 1.79407475  
## 2 1.49471770 0.64046948 0.33160357 -0.9212644 1.66406934  
## 3 0.95115659 -0.78078008 0.94857419 -0.2493971 1.40405850  
## 4 -0.12720099 -1.40068680 -0.55676305 -0.5181440 1.14404767  
## 5 -0.44595691 -0.17599303 -0.13715788 0.5165315 1.01404225  
## 6 1.55068835 -0.90929733 1.44206185 0.5165315 0.88403684  
## 7 -0.84328701 1.19233767 -0.13715788 1.9005780 0.75403142  
## 8 2.19342822 1.69884682 1.21997020 -1.4856328 0.62402600  
## 9 0.49324288 0.69338835 -0.30994519 -1.2975100 0.49402058  
## 10 -0.54513567 0.02056276 -1.17358561 0.0865365 0.36401517  
## 11 0.37238318 -1.53676389 1.12136150 -0.7062668 0.23400975  
## 12 -1.25384094 -0.02479627 -1.69179948 1.5915191 0.10400433  
## 13 1.04110942 1.61568860 0.03548136 -0.8406403 -0.02600108  
## 14 -0.34969969 0.82190560 -0.40870195 -0.4106453 -0.15600650  
## 15 -1.26660348 0.03568244 -0.45800630 1.9274527 -0.28601192  
## 16 -1.10914759 -0.22891190 0.06020757 1.2824602 -0.41601733  
## 17 0.80123521 0.12640049 0.23299488 -0.8003283 -0.54602275  
## 18 0.19401518 -0.41034801 0.38105598 -0.4912693 -0.67602817  
## 19 -1.32595697 -0.52374558 -2.25946575 0.1268485 -0.80603359  
## 20 -0.66199746 -1.73331968 0.82523929 -0.3434585 -0.93603900  
## 21 -1.18879813 -0.23647174 -0.30994519 0.4762195 -1.06604442  
## 22 0.34562798 -0.25159141 0.65245198 0.3015340 -1.19604984  
## 23 0.08284271 -1.41580648 1.68887971 1.3227722 -1.32605525  
## 24 -1.24323112 1.63080828 -1.37109913 -0.8272029 -1.45606067  
## 25 0.18263653 1.19233767 -1.02552451 -1.3109474 -1.58606609

str(wine2)

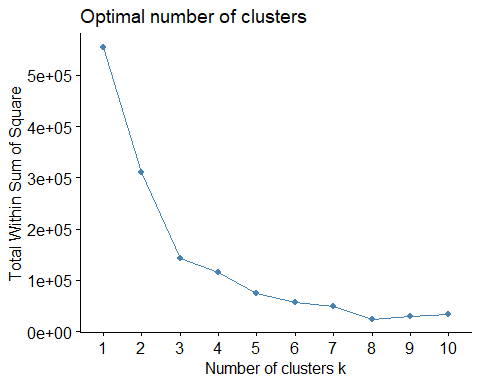
## Classes 'tbl\_df', 'tbl' and 'data.frame': 25 obs. of 5 variables:  
## $ Price : num 7.5 8.04 7.69 6.98 6.78 ...  
## $ WinterRain : int 600 690 502 420 582 485 763 830 697 608 ...  
## $ AGST : num 17.1 16.7 17.1 16.1 16.4 ...  
## $ HarvestRain: int 160 80 130 110 187 187 290 38 52 155 ...  
## $ Age : int 31 30 28 26 25 24 23 22 21 20 ...  
## - attr(\*, "spec")=List of 2  
## ..$ cols :List of 7  
## .. ..$ Year : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## .. ..$ Price : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## .. ..$ WinterRain : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## .. ..$ AGST : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## .. ..$ HarvestRain: list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## .. ..$ Age : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_integer" "collector"  
## .. ..$ FrancePop : list()  
## .. .. ..- attr(\*, "class")= chr "collector\_double" "collector"  
## ..$ default: list()  
## .. ..- attr(\*, "class")= chr "collector\_guess" "collector"  
## ..- attr(\*, "class")= chr "col\_spec"

summary(wine2)

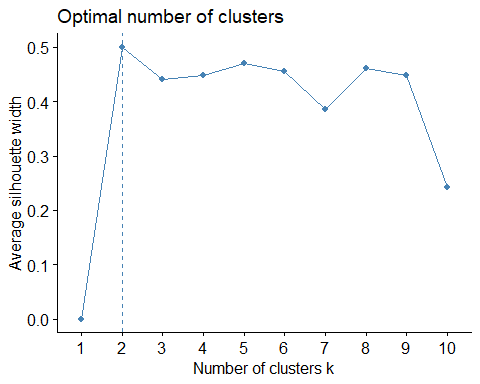
## Price WinterRain AGST HarvestRain   
## Min. :6.205 Min. :376.0 Min. :14.98 Min. : 38.0   
## 1st Qu.:6.519 1st Qu.:536.0 1st Qu.:16.20 1st Qu.: 89.0   
## Median :7.121 Median :600.0 Median :16.53 Median :130.0   
## Mean :7.067 Mean :605.3 Mean :16.51 Mean :148.6   
## 3rd Qu.:7.495 3rd Qu.:697.0 3rd Qu.:17.07 3rd Qu.:187.0   
## Max. :8.494 Max. :830.0 Max. :17.65 Max. :292.0   
## Age   
## Min. : 5.0   
## 1st Qu.:11.0   
## Median :17.0   
## Mean :17.2   
## 3rd Qu.:23.0   
## Max. :31.0

## Task 7 I would have chosen 3 clusters via the first method but the second method shows 2 so we will go with that.

set.seed(123)  
fviz\_nbclust(wine2, kmeans, method = "wss")



set.seed(123)  
fviz\_nbclust(wine2, kmeans, method = "silhouette") #maximize how well points sit in their clusters

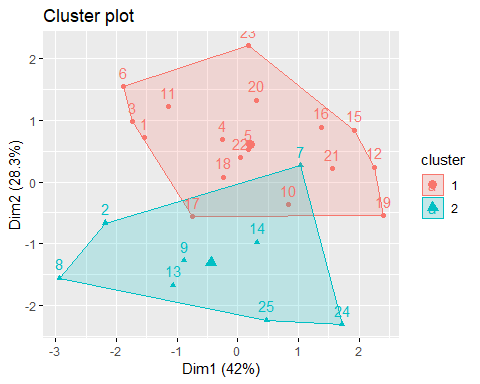


## Task 8

set.seed(1234)  
clusterswine2 <- kmeans(wine2, 2)  
clusterswine2

## K-means clustering with 2 clusters of sizes 17, 8  
##   
## Cluster means:  
## Price WinterRain AGST HarvestRain Age  
## 1 6.953647 531.4706 16.57550 171.2941 17.05882  
## 2 7.308575 762.1250 16.36874 100.2500 17.50000  
##   
## Clustering vector:  
## [1] 1 2 1 1 1 1 2 2 2 1 1 1 2 2 1 1 1 1 1 1 1 1 1 2 2  
##   
## Within cluster sum of squares by cluster:  
## [1] 168100.75 69322.51  
## (between\_SS / total\_SS = 57.2 %)  
##   
## Available components:  
##   
## [1] "cluster" "centers" "totss" "withinss"   
## [5] "tot.withinss" "betweenss" "size" "iter"   
## [9] "ifault"

fviz\_cluster(clusterswine2, wine2)



## Task 9

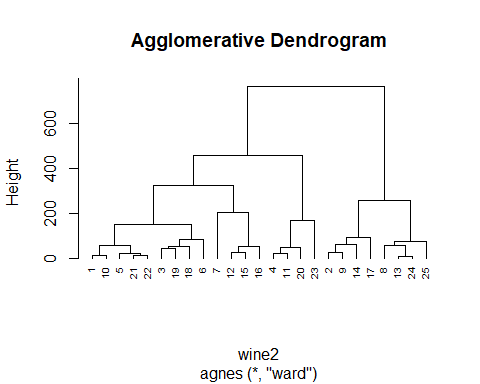
Use agglomerative clustering to develop a dendogram for the scaled wine data. Follow the same process from the lecture where we used a custom function to identify the distance metric that maximizes the âagglomerative coeï¬cientâ. Plot the dendogram.

m = c( "average", "single", "complete", "ward")  
names(m) = c( "average", "single", "complete", "ward")  
  
ac = function(x) {  
 agnes(wine2, method = x)$ac  
}  
map\_dbl(m, ac)

## average single complete ward   
## 0.8125463 0.7384114 0.8973199 0.9330872

Ward’s is highest and will be used to develop clusters.

hc = agnes(wine2, method = "ward")   
pltree(hc, cex = 0.6, hang = -1, main = "Agglomerative Dendrogram")

 #Task 10

Repeat Task 9, but with divisive clustering.

hc2 = diana(wine2)  
pltree(hc2, cex = 0.6, hang = -1, main = "Divisive Dendogram")

